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BASIC
Basic Avionic System Integration Concept

ANNUAL PROGRESS REPORT FOR FISCAL YEAR 1980

OCTOBER 1980

NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA 18974

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This report presents the progress of the BASIC Laboratory for Fiscal Year 1980 including descriptions of the various areas of effort, equipments acquired and installed during the year and program scheduling.

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FOREWORD

The Naval Air Development Center (NAVAIRDEVCEN) established the BASIC program to enhance the transitioning of emerging technologies to Navy weapons systems platforms for fleet use. Technology is advancing rapidly.

Integrated circuits have progressed to large-scale integration (LSI), very large-scale integration (VLSI), very high speed integrated circuits (VHSIC), and high circuit/device densities per chip. This has revolutionized the application of digital techniques.

System architecture has also progressed with the use of advanced integration technology employing multiplex. Functions can now be distributed more efficiently via the multiplex bus, thus increasing the reliability, survivability, and maintainability of system operation. The computer, formerly a single control device or central complex, can now be configured as multiple processors in federated or distributed system architectures. Processor control and data information are exchanged on the multiplex bus. Advances in circuit densities, memory, and software have reduced computer size and increased computer capability. The new microprocessors are increasingly being imbedded in individual equipments or functional units.

BASIC provides a laboratory (operation initiated in FY77) for integrating advanced avionic technology (6.2 and 6.3) into an advanced distributed multiprocessor architecture for demonstration and evaluation. The laboratory's multiplex data transfer system permits easy avionic reconfiguration of subsystems and components, whether they are breadboard advanced development, engineering development, or production models.

Some technologies that have been brought into the laboratory are the integrated inertial sensor assembly (IISA), voice multiplex, data multiplex, bus monitoring, fiber optics, multisensor correlation algorithms, and an adaptable distributed multiprocessor architecture.

Among the programs that the BASIC Laboratory has supported in FY80 are LAMPS, the F-14, and the CH-53. BASIC offers support to weapon systems platform managers in successive program phases as follows:

- o Pre-DSARC I (Concept Formulation)
  - -- analyze risk areas
  - -- validate concepts in support of critical issues
  - -- evaluate/validate alternatives
  - -- identify/resolve issues
  - -- provide a documented technology data base

- Pre-DSARC II (Demonstration and Validation)
  - -- off-line (not in platform laboratory)
  - -- independent Navy assessments/validation
  - -- higher-risk technology evaluation/validation/demonstration
- Post-DSARC II
  - -- off-line (evaluation/validation/demonstration)
  - -- weapon system updates
  - -- other support as required

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

INTRODUCTION

1.1 OBJECTIVE

This report presents the progress and accomplishments of the BASIC program during FY80 and provides a brief glimpse of the efforts planned for FY81. Included in Appendix A is a list of documents generated during the year by the program efforts.

The BASIC program and related laboratory development were initially funded primarily by 6.2 monies. In FY80, the program was partly funded with 6.2 monies but was mainly supported by monies from the various project offices and programs for which BASIC performed specific tasks.

A description of the laboratory implementation is in Appendix B. This implementation represents the development of an advanced distributed multiprocessor system architecture, a multiplex integration system, and generic system configuration. The BASIC Laboratory development and implementation have been guided by the BASIC Laboratory Architecture Plan.

SECTION 2

PROGRESS AND ACCOMPLISHMENTS

2.1 GENERAL

The BASIC facilities include a 1553 multiplex system, AN/AYK-14 Navy standard avionics computers, Z-2 microcomputers, and a VAX 11/780 computer integrated into a system configuration (see Figure B-1) with system test, multiplex test, and data reduction capabilities. These facilities have been utilized during FY80 by various programs, platforms, and technologies. Such usage increases the BASIC capabilities available to additional users of the laboratory.

2.2 PLATFORM SUPPORT

BASIC has provided support to various platforms and programs as described in the following paragraphs.

2.2.1 F-14 Multisensor Correlation (MSC) Interception Algorithm Development and Demonstration

The F-14 Project Office contractor developed the performance definition, mathematical models, and associated preprocessing required for the Bayesian MSC algorithm implementation. Track file modeling for velocity and altitude, and cross-section and engine ID models were compiled, documented, and installed in the BASIC Laboratory computers. The Bayesian algorithm was installed, along with the postprocessing algorithm required for BASIC Laboratory controls.

The BASIC Laboratory MIL-STD-1553 multiplex provided system integration and data transfer. BASIC Laboratory personnel provided the configuration checkout and BASIC/MSC simulation coding, implementation, and debugging. The BASIC project also provided the MSC simulation validation and exercising.

Two reports were generated by VEDA Inc. for the F-14 efforts. They were "BASIC/MSC Model Report," Report Number 33075-80U/P0423-1, dated 11 July 1980 and "BASIC/MSC Validation Plan," Report Number 33177-80U/P0423-1, dated 16 July 1980.

Utilization of the in-place BASIC Laboratory provided significant cost and time savings to the F-14 project. Laboratory construction time and costs were eliminated. Equipment purchases were saved by the available BASIC equipment/software including the: (1) VAX 11/780; (2) AN/AYK-14's and CCU's, bus control software, and multiplex bus interfaces; and (3) Z-2 microcomputers and the Chromatics color display terminal.

The BASIC configuration was operational, which saved system integration, test, and debugging costs. Other cost savings were in computer maintenance, laboratory maintenance, and support personnel.

Initial BASIC MSC capabilities were developed from an IR/IED-funded MSC task in FY79. Performance of the F-14 MSC validation task has enhanced BASIC's capabilities for higher-level MSC algorithm installation and validation.

2.2.2 CH-53 Helicopter Integration System (HIS)

The CH-53 Project Office, to effect early integration at the lowest possible cost, is performing its avionics integration in the BASIC Laboratory. The laboratory's test simulation and software facilities are appropriate for this integration.

BASIC is making its facility available to the CH-53 program along with support and expertise to integrate the HIS avionic system in the BASIC Laboratory. BASIC is also providing development support to produce special-purpose integration test software. This software permits exercising and monitoring equipment connected to the MIL-STD-1553 data bus to test system operational software. BASIC is also assisting HIS personnel in the development and execution of problem scenarios for laboratory testing and demonstration of the HIS.

2.2.3 EC(X) -- TACAMO Planning

TACAMO, an airborne element of the U.S. strategic forces, performs a classified communications mission.

The BASIC Laboratory generated a document, "TACAMO Avionics System Upgrade -- Proposed Approach," Report Number 4092TM-80-BASIC-004, recommending a two-stage acquisition process to develop both an integrated Communications, Navigation, and Identification -- Friend/Foe (CNI) Flight Deck System and an integrated mission radio control/display suite for the TACAMO aircraft. Multiplex bus techniques (per MIL-STD-1553B) would be used for interconnecting system components. Both equipment suites would be evaluated in off-the-shelf versions in the BASIC Laboratory as a prelude to the preparation of procurement specifications for equipment tailored to TACAMO's needs.

With the use of off-the-shelf equipment, useful system design information could be obtained early in the program. Specifications would more closely match requirements and there would be a facility for independent assessment of the developing contractors' concepts.

2.3 PROGRAM SUPPORT

The BASIC project has supported various programs. Its support includes current laboratory activities and BASIC personnel efforts as well as planning for future BASIC support efforts.

2.3.1 Signal Processing Architecture Methodology (SPAM)

The SPAM program was designed to significantly reduce software, integration, and support costs of high-performance military signal processing systems. It will provide hardware and software interface specifications which can be used by the electronic processing system development community during competitive procurement of signal processing systems or modules. The SPAM program consists of the following phases:

- o Definition of a set of widely applicable processing functions (macro functions)
- o Development of standard high-order language (Ada) implementation for each of these functions
- o Demonstration and evaluation of each implementation
- o Evaluation of alternative signal processing architectural concepts, including very high-speed integrated circuits (VHSIC) and very large-scale integration (VLSI)
- o Development of a signal processing simulation system design tool
- o Feasibility testing of standard hardware and software module interface specifications

The BASIC Laboratory has been participating in the first phase of this program by surveying the circa 1985 signal processing requirements of the NAVAIRDEVCEN's Communication Navigation Technology Directorate (CNTD). The survey's purpose and requirements have been explained to each CNTD division. The Communication, Command, and Control Division survey has been completed. A report has been issued entitled "SPAM Communication Signal Processing Algorithm Survey," Report Number 4092TM-81-BASIC-002, dated October 1980. The Navigation Analysis and System Development Division and the Precision Navigation System Development Division surveys have been partially completed. Only the Ship/ Submarine Navigation/Air Sensor Division survey has not yet been initiated.

2.3.2 Global Positioning System (GPS)

The Phase II Development Test and Evaluation (DT&E) of the User Equipments (UE's) of the Navstar GPS is scheduled to begin during the first part of 1982. The DT&E will culminate in an operational readiness DT&E (DT&E/OR) to ascertain that the UE's are ready for Initial Operational Test and Evaluation (IOT&E). The results of the IOT&E, in turn, should support an Approval for Service Use (ASU). The Navstar GPS is a joint service program with each of the services having primary test responsibility for portions of the GPS. The Navy is responsible for testing various versions of the UE's on the A-6E, P-3C, CV-59, and SSN-701 host vehicles. The Navy must plan and conduct adequate tests to resolve all critical issues and determine the military usefulness of the GPS.

To aid in test planning, BASIC prepared cross-reference charts referencing the critical issues to be resolved. The charts showed the parameters to be measured to resolve these critical issues and the test phases during which they are to be measured. The critical issues were taken from the Test and Evaluation Master Plan (TEMP) No. J-190; Navy Annex; YEN-77-266, Annex 2, Revision A, dated 25 April 1980 (Part 2.6). The parameters listed in the charts are specified requirements taken from various sources. The main source document is the User System Segment Specification, SS-US-200, dated 31 January 1979. The source document paragraph where the parameters were found is listed on the charts. The test phases during which the parameters are measured were determined from the descriptions of the test phases in Section 4, Quality Assurance Provisions, of SS-US-200. A preliminary estimate of the types of instrumentation required to measure each parameter is included in the charts. The cross-reference charts, together with an introductory explanation and a description of the instrumentation, were submitted as a paper.

A preliminary plan, "BASIC Support for GPS User Equipment/HOST System Integration," Report Number 4092TM-81-BASIC-003, generated in October 1980, describes the proposed BASIC Laboratory support of the GPS User Equipment Integration Test Program. The main objective of the proposed BASIC/GPS testing is to augment and supplement the achievement of ASU for GPS UE in advanced Navy aircraft systems (LAMPS Mk-III, F-18, etc.). The role of the BASIC Laboratory would consist of:

- Simulating four host platform avionic systems (CH-53, LAMPS, F-18, and F-14)
- Simulating the interfaces between the host systems and GPS
- Conducting integration tests with the simulated system
- Substituting actual GPS UE's and completing the integration testing

The planning document describes each of these phases and provides schedule and budgetary cost data.

2.3.3 Joint Tactical Information Distribution System (JTIDS)

The JTIDS distributed time division multiple access (DTDMA) terminals are undergoing testing at the Naval Ocean Systems Command (NOSC) in California. NAVAIRDEVCEN is involved in supervising and directing the tests. BASIC is aiding in collecting test data and information from testing and also in test report generation. Three interim test reports and a final test report will be generated. Delivery (in rough draft form) has been made of "JTIDS DTDMA Performance Test Report No. 1, AN/USQ-72 Bench Tests" and "JTIDS DTDMA and TACAN Performance Interim Status Report, AN/USQ-75 Acceptance Tests."

2.3.4 Advanced Aircraft Armament System/Aircraft Armament Interoperability Interface (AAAS/A^2I^2)

The BASIC project is conducting an analysis and study of data word/data message standardization and its impact on AAAS/A^2I^2 application in a weapon system. MIL-STD-1553 has provided standardization of the protocol and interfaces for a 1 Mbps serial time division multiplex.

This study examines the data word as defined by MIL-STD-1553 and provides guidance and recommendations to standardize the data content of the word and/or groups of words forming a message or data transfer.

The initial phase of the study, examining data being transferred in various aircraft multiplex systems, has been completed. The various types of data have been identified and word standardization guidelines have been recommended. The interim study results were presented to the Naval Weapons Center (NWC) and to the Air Force at Eglin Air Force Base. A preliminary report was generated, "AAAS Multiplex Armament Data Word Standardization Study," Report Number 4092TM-80-BASIC-005 (Draft), dated September 1980.

In FY81 the specific recommendation for Naval Weapons Center (NWC) AAAS/A^2I^2 data words will be developed. Impacts will be identified and a final report issued.

2.3.5 Advanced Sensor Processing and Correlation (ASPC) Program

BASIC has generated a preliminary program support plan entitled "BASIC ASPC Support Plan FY81 through FY84," Report Number 4092TM-80-BASIC-006, dated September 1980. The plan is for Phase 1 of the program and covers the years FY81 through FY84. The objectives of the ASPC program are to develop, computer program, and demonstrate an acoustic (sonobuoy data) environment correlation algorithm which speeds up airborne antisubmarine warfare (ASW) localization. ASPC is concerned initially with developing the processing and correlation technology necessary to improve airborne ASW localization by processing and correlating acoustics, electronic warfare support measures (ESM's), and radar data.

The BASIC Laboratory will support the ASPC program by providing a host system as a sensor simulation facility, laboratory facilities, and personnel for installation of computer programs. A system demonstration will be provided and the results, recommendations, and conclusions documented.

2.3.6 Acoustic Generation System (AGS)

In FY80 BASIC generated the "BASIC Acoustic Generation System (AGS) Support Plan," Report Number 4092TM-80-BASIC-007, dated October 1980, for the Acoustic Generation System (AGS) program. The objective of the AGS program is to enhance NAVAIRDEVCEN's laboratory capability to produce real-time simulated acoustic signals in support of advanced program concept verification and acoustic algorithm development and acoustic simulation in a laboratory environment.

The BASIC Laboratory will support AGS real-world acoustic simulation by providing the host data processor for problem control and geometry functions. Correlation of acoustic target data with other sensor information such as radar and electronic support measures (ESM's) may be required and will be implemented within this simulation computer. The laboratory will also interface and integrate this capability with Advanced Integrated Display System (AIDS) and Advanced ASW Processing Techniques (ADAPT) to fulfill the AGS NAVAIRDEVCEN capability.

A two-phase development approach will be used to develop the acoustic generator. The AGS will provide the capability to simulate sonobuoys as defined in Table 2-1. The first (demonstration) phase will include line target generation in a three-layer ocean with a limited number of buoys and a single target. The second (full capability) phase will incorporate passive target broadband noise modeling, directional noise generation, additional buoy capability, and three targets into the AGS in order to provide the system with a comprehensive acoustic simulation/ line generation capability.

2.3.7 Acoustic Performance Prediction (APP) Program

BASIC has made the VAX 11/780 computer capabilities available to the APP group. A remote terminal is used at the APP location to access the UNIX operating system.

2.3.8 Carrier-Based Antisubmarine Warfare Module (CV-ASWM)

BASIC has provided support to the CV-ASWM program for AN/UYK-7 to Z-2 microcomputer interfacing. A black box was built to interface a Univac 1532 (peripheral of the AN/UYK-7) to the Cromemco Z-2 microcomputer. Software was developed for interface on the Z-2 and a software report was issued.

2.3.9 Magnetic Anomaly Detection Tactics (MADTACS)

MADTACS program support was provided through the use of the BASIC AN/AYK-14 computer for software development.

2.3.10 Voice Recognition and Synthesis (VRS)

The main objective of the BASIC VRS support efforts is to develop a system configuration to enable experimentation with VRS technology in a

TABLE 2-1. AGS SENSOR SIMULATION CAPABILITY

MODE	SONOBUOY TYPE	NUMBER OF CHANNELS	
		DEMONSTRATION	FULL CAPABILITY
LOFAR	AN/SSQ-41A	2	8-16
DIFAR	AN/SSQ-53	1	2-4
BT	AN/SSQ-36	1	1
ANM	AN/SQ-57A	1	1
CASS	AN/SSQ-50	1	4
DICASS	AN/SSQ-47	1	4
Range Only	AN/SSQ-47	1	4

generalized avionics system with architecture designed around the 1553B multiplex bus. The elements of this configuration are:

1. An RS-232 data link connection between the NOVA-800 computer in the AIDS Laboratory and the ACTRON remote terminal in BASIC Laboratory.

2. An audio switching unit to interface between cockpit type headsets and microphones in the BASIC Laboratory and the VRS system in AIDS to permit voice input and output from either AIDS or BASIC (or both).

3. Avionics equipment to receive digitized voice inputs, recognize spoken words, process information into control outputs, and provide synthesized voice outputs from specific data inputs.

4. Control, display, and simulation to provide bus and problem control, display of mission parameters during the performance of experiments, and simulation of avionics system characteristics to provide a "real-world" data flow for voice experiments.

BASIC gave a demonstration to the Army in October 1980 of an operator speaking specific words and word sequences into a microphone at an operator's position with a visual display similar to that in the Army's integrated avionics control system (IACS) secondary control unit (SCU). The words spoken into the microphone caused the IACS display to be changed as if by manual operation of pushbuttons. In addition, the corresponding commands occurred on the multiplex bus to the IACS cable control units (CCU's), causing the control action to occur (for example, a change of the selected radio frequency or preset channel). Expanded capability for audio response by the VRS, confirming that it has understood the operator's verbal command, is being implemented.

2.4 TECHNOLOGY INTEGRATION DEMONSTRATION

The BASIC project utilizes some technology products such as multiplex terminals, a bus controller, and the software/firmware for their operation as a part of the in-place laboratory configuration. Some technology products are integrated, evaluated, and demonstrated as a part of the system configuration. After their demonstration and evaluation, they may be removed or returned elsewhere. Some technology products may be simulated, depending on their availability or other factors.

A description of the BASIC Laboratory and the equipment in it is provided in Appendix B.

2.4.1 Ring Laser Gyronavigator (RLGN)

The RLGN was integrated with the MIL-STD-1553 bus system. A demonstration of data transfer on the multiplex bus was conducted and a test report released. Further information can be obtained from the report entitled "RLGN/1553A Interface Tests," Report Number 503-TM-79-BASIC-011, dated 5 December 1979.

2.4.2 Voice Multiplex

A laboratory evaluation was performed on the Garrett Air Research 1553B data bus voice multiplex system. When received at the BASIC Laboratory, the Garrett system was a "stand-alone" demonstrator system; the feasibility of mixing the voice-encoded data with standard data had not been explored. The evaluation studied the feasibility of mixing ordinary 1553B data transfers with 1553B voice-encoded messages from the Garrett system by integrating Garrett system components and existing laboratory equipment on the BASIC Laboratory 1553 bus.

Successful test mixing of data indicates that a derivative system has possible application in these types of aircraft:

a. A two-seat aircraft with a 10- or 20-percent duty cycle (percent of time the bus is occupied with voice data transfer, as defined in Section 3), which allows adequate free time to provide all other data transfer

b. A single-seat aircraft with one station used for radio applications, having a 10- or 20-percent duty cycle

c. A large multistation aircraft where 5 to 10 stations would require a duty cycle over 50 percent but still allow a small quantity of unused time for limited transfer of other data

The Garrett system consists of a warning tone generator panel and a bus controller that controls five audio stations. Each audio station has a headset, six input channels (one for voice and five for warning tones), and controls for selecting volume, push-to-talk, and stations to receive the signal.

Each station can send groups of 256 bits at 1 Mbps on the multiplex bus. The 256 bits of data are obtained by 25 kbps or 50 kbps sampling of the audio input signal using a continuously variable slope delta (CVSD) modulator.

The bus format follows MIL-STD-1553A. The bus operates in a modified polling contention mode as specified in MIL-G-85013. In this mode, the Garrett bus controller transmits a "bus offer" word to a station and monitors the bus activity to determine when to offer the word to the next station.

The bus controller maintains a timing sequence by internally generating a regular cue, or "frame mark," and starts the bus offer sequence with the first audio station at this internal frame mark. The frame mark intervals are 10.24 ms for a 25-kbps sampling rate and 5.12 ms for a 50-kbps sampling rate. These intervals (frames) allow each station to send 256 bits of audio information at each bus offer, to maintain the selected sampling rate, and to allow sufficient time to perform the required bus operations.

For more information, refer to "Test Report: BASIC Laboratory Evaluation of Data Bus Voice Multiplex System," Report Number 4092TM-80-BASIC-001, February 1980.

2.4.3 AN/AYK-14 Bus Controller

The AN/AYK-14 is the Navy standard avionics computer with a MIL-STD-1553 interface. BASIC has interfaced the AN/AYK-14 to the multiplex bus and has developed and implemented a multiplex bus controller executive for redundant bus control and redundant multiplex bus operation. The executive has been developed to be so flexible that remote terminals may easily be added to or deleted from the BASIC configuration and data transfers can be easily added to, modified, or deleted from the system.

The AN/AYK-14 was used for the MSC (IED) development and demonstration and as a part of the executive development for distributed processing (IR).

2.4.4 Multisensor Correlation (MSC)

An MSC algorithm demonstration was conducted under IED funding. ESM and radar systems were simulated in the Z-2 microcomputers. The Chromatics color display was used for operator inputs, control, and display. Problem geometry and environment were implemented in the Chromatics terminal.

The multiplex bus system was used to transfer data between the elements of the configuration. The Chromatics color video terminal was interfaced to the multiplex bus system through a Z-2 microcomputer.

2.5 LABORATORY DEVELOPMENT

The BASIC Laboratory capabilities will increase with the efforts accomplished in FY80 and the planned effort for FY81.

2.5.1 Architecture Plan Implementation

FY80 provided increased capabilities in the multiplex system with universal bus controller executive development; bus controller operation; bus monitoring with CONRAC and Fairchild products; and bus interfacing with microcomputers, tri-service remote terminals, cockpit management systems (including the CMS-80), and the Army's integrated avionics and control system (IACS).

Voice multiplex and voice recognition and synthesis (voice-interactive configurations) have been integrated with the laboratory configuration providing BASIC with unique architectural capabilities.

Distributed processing has been implemented with five Z-2 microcomputers interfaced with the multiplex bus as well as three AN/AYK-14's and the VAX 11/780.

2.5.2 VAX 11/780 Benchmark Testing

The VAX 11/780's capabilities have been explored by benchmark testing to develop a core of knowledge to provide VAX software assistance to programs, projects, and/or technology group users.

2.5.3 ESM, Radar, and Navigation

Simulations have been developed, installed, and implemented on Cromemco Z-2 microcomputers. These simulations have resulted from F-14 project support, MSC IED development, and the RLGN interfacing and testing. They provide increased support capabilities for programs such as ASPC.

2.5.4 VAX 11 780 - MIL-STD-1553 Multiplex Bus Interface

A universal remote terminal (URT) has been installed to interface the VAX 11/780 with the MIL-STD-1553 multiplex buses. This interface permits any element of the BASIC Laboratory configuration with a multiplex interface to communicate with the VAX. Similarly, it permits the VAX to communicate with: (1) any BASIC Laboratory configuration element interfaced with the MIL-STD-1553 bus, (2) elements external to the BASIC Laboratory equipment, or (3) computers interfaced to the BASIC multiplex bus.

SECTION 3

PROGRAM SCHEDULE

3.1 MILESTONES AND SCHEDULES

The milestones and schedules for the BASIC program during FY80 are shown in Figures 3-1 through 3-5. These milestones provide for the continued development of the laboratory generic system configuration with the implementation of the distributed multiple processing system architecture. Support is given to the F-14, CH-53-HIS, AAAS, SPAM and VRS programs.

3.1.1 Milestones

The milestones accomplished during FY80 include the tasks listed below:

1. CH-53-HIS (Helicopter Integration System) for CH-53 (Figure 3-1)

2. F-14-MSC Development and Demonstration Program (Figure 3-2)

3. AAAS-MIL-STD-1553 Word Standardization Analysis (Figure 3-3)

4. VRS-System Integration and Demonstration (Figure 3-4)

5. Signal Processing Architecture Methodology Support (SPAM) (Figure 3-5)

3.2 FUTURE EFFORTS

The future efforts of the BASIC Laboratory will concentrate on:

1. Continuing phased implementation of the architecture implementation plan and core avionic capability

2. Integrating advanced technology products into the BASIC Laboratory for test and demonstration in a system context

3. Implementing interactive control and display capability using Advanced Integrated Display System (AIDS) concepts

4. Implementing dynamic system operational capabilities to which mission-unique hardware and software technology products can be integrated and demonstrated

5. Supporting program offices, such as F-14, CH-53, EC(X), GPS, and others as required

6. Providing feedback to the technologists on new system architectures and the performance of technology products integrated into these advanced system configurations

7. Implementing FY81 support efforts for F-14, ASPC, AAAS, EC(X), and E-2C

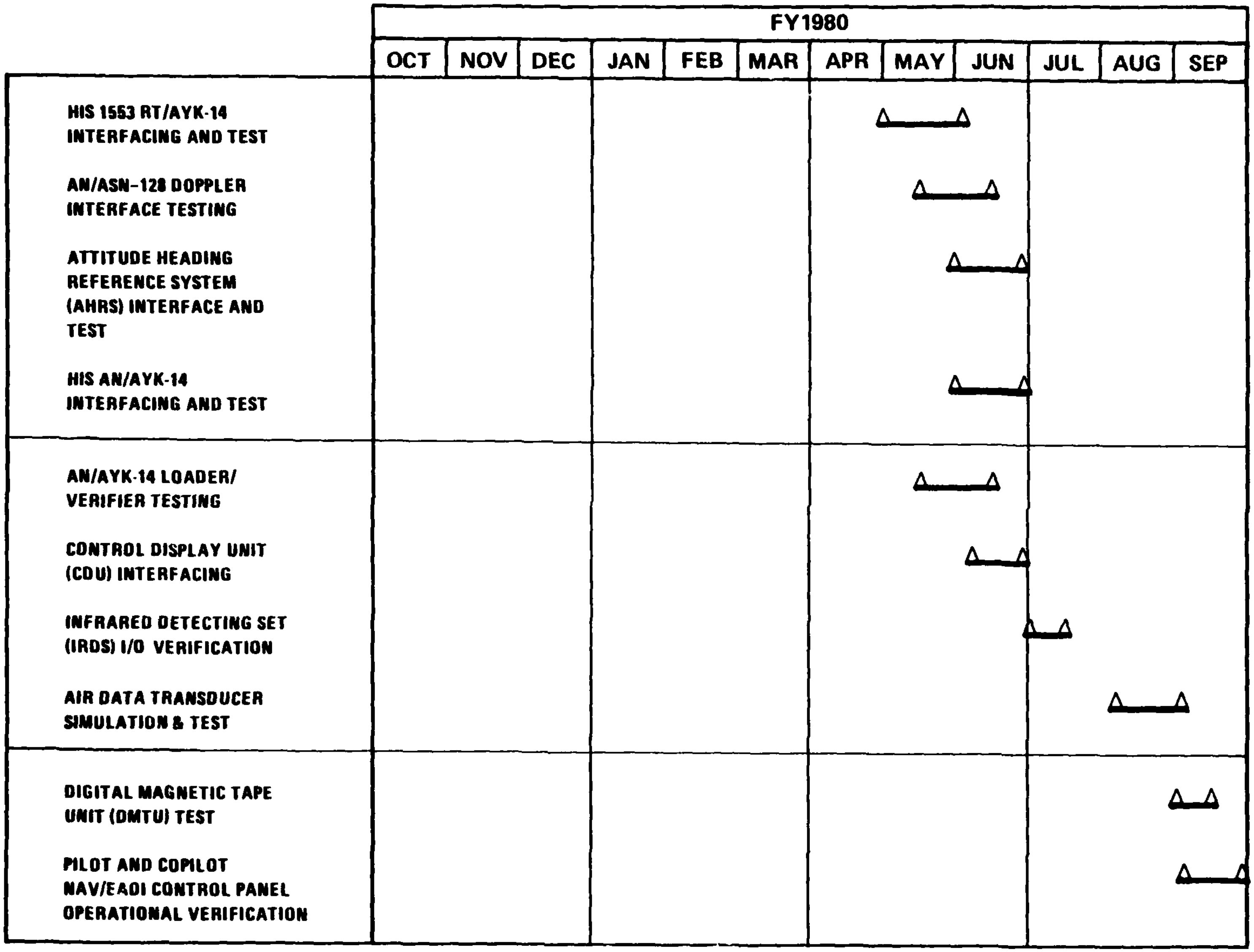

Figure 3-1. HIS Schedule

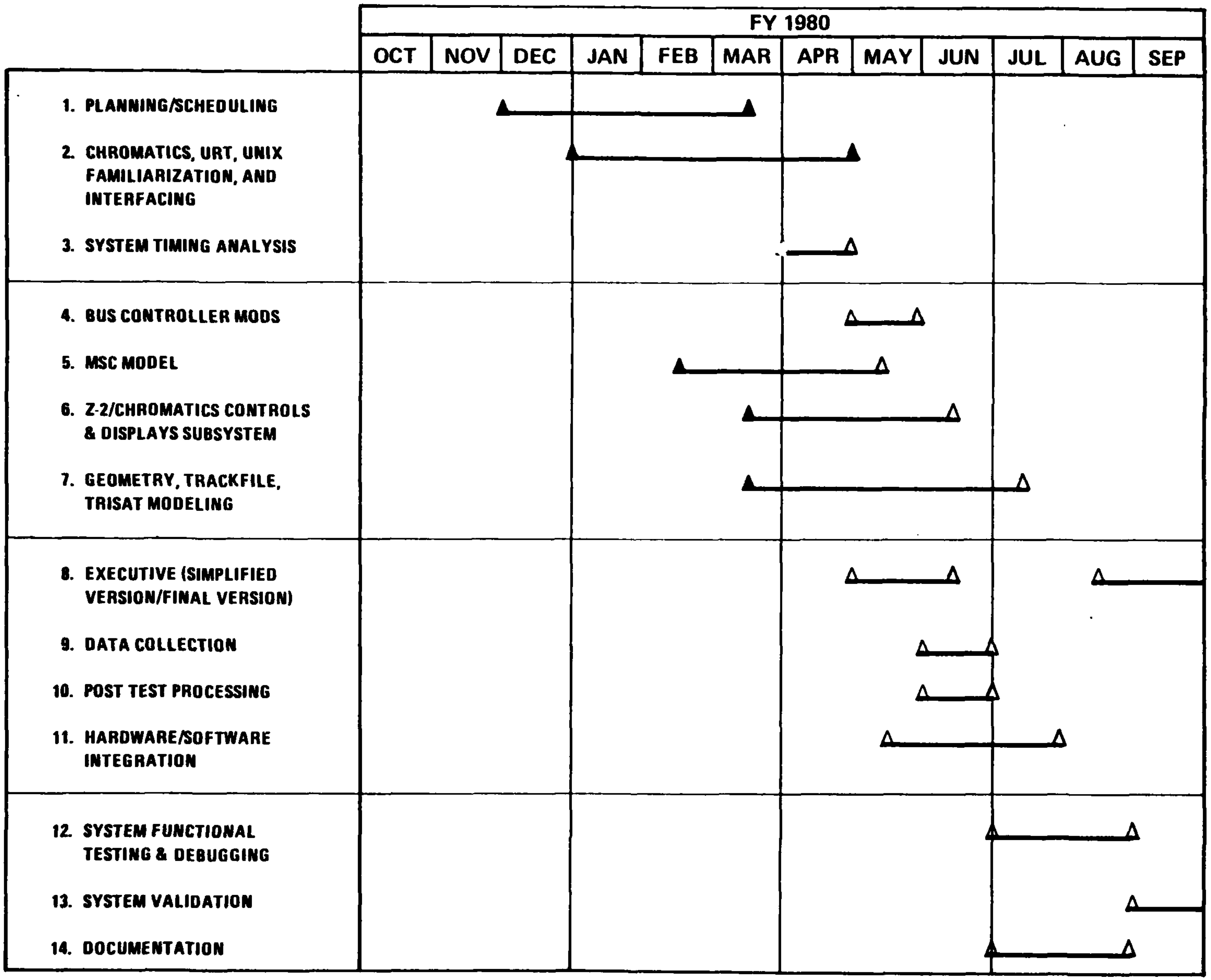

Figure 3-2. F-14 Schedule

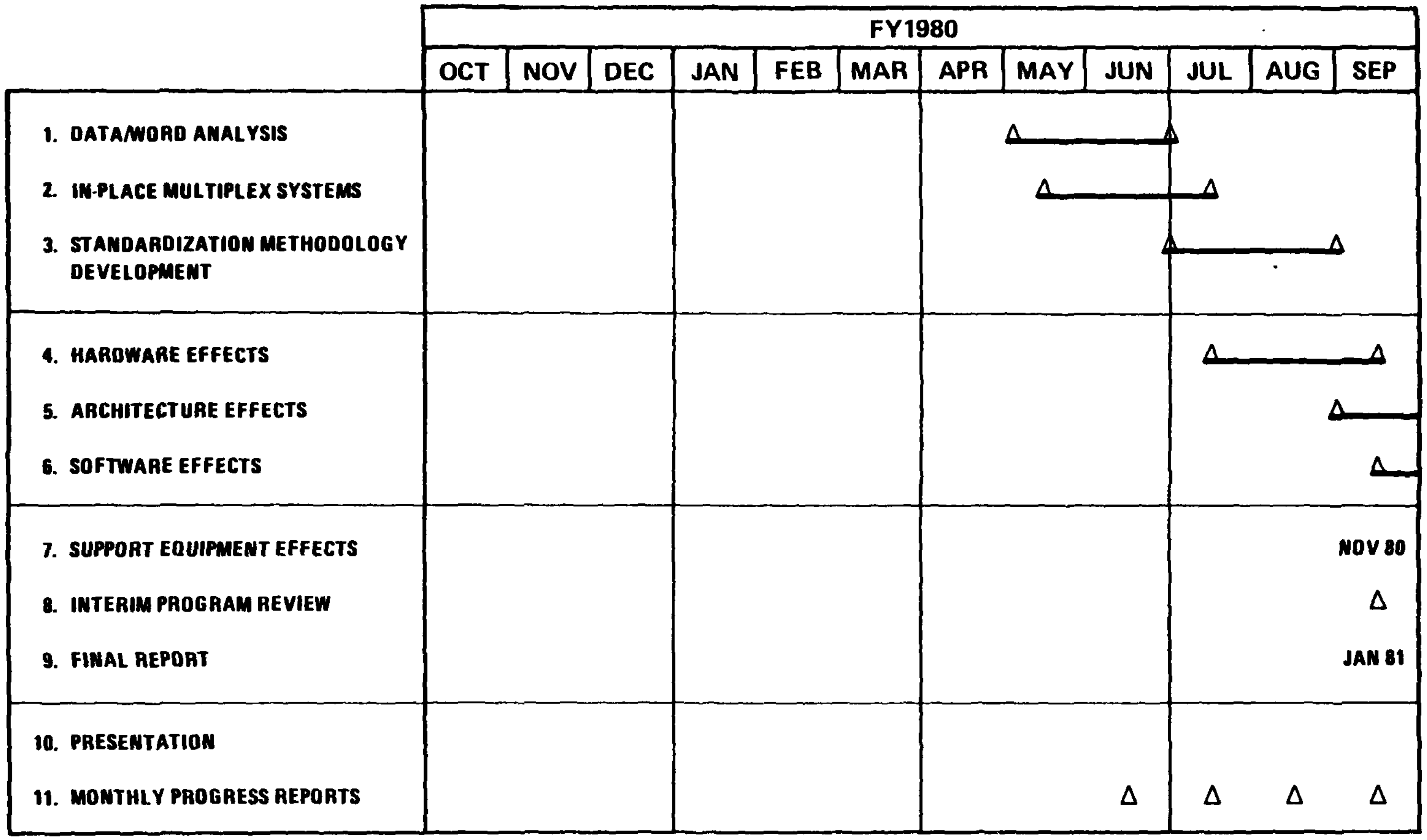

Figure 3-3. AAAS Schedule

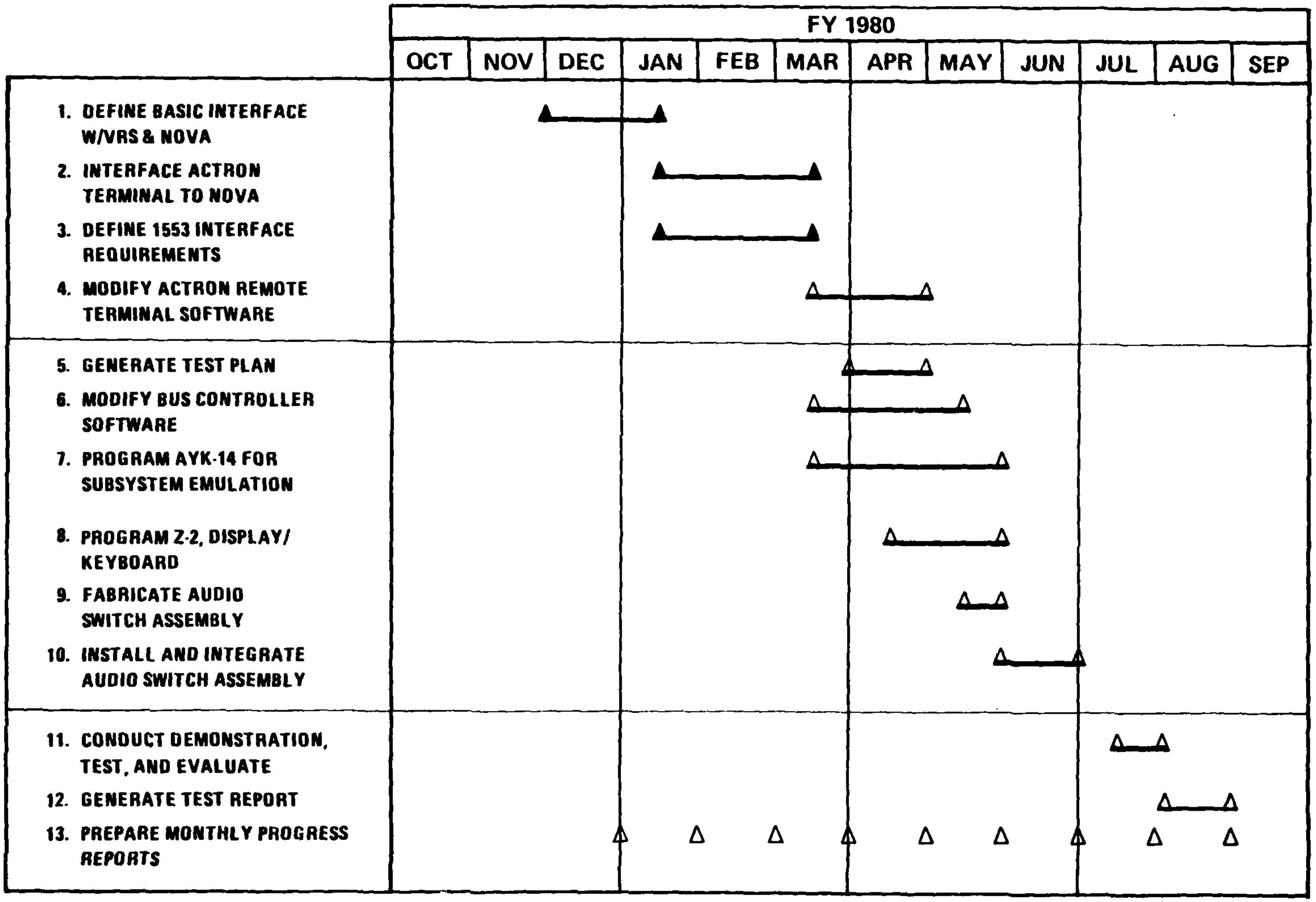

Figure 3-4. VRS Schedule

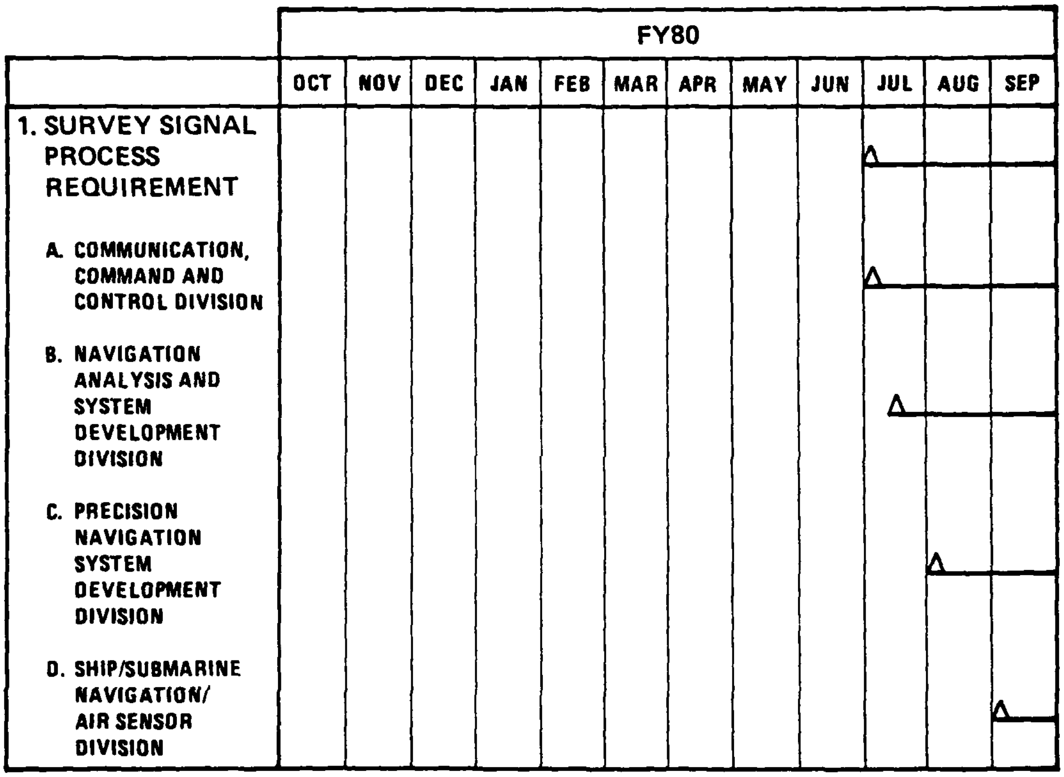

Figure 3-5. SPAM Schedule

Future software efforts will include:

1. Implementing a multisensor correlation algorithm, including pre- and postprocessing

2. Developing sensor simulation software -- radar, ESM, forward-looking infrared (FLIR), electro-optic, etc.

3. Modifying bus controllers and multiplex terminal software to accommodate various laboratory configurations

4. Providing display and control software

5. Providing additional T&E software

3.3 PROGRAM PLAN

Detailed milestone charts and schedules for FY81 and subsequent years are shown in the "BASIC Program Plan," Report Number 4092TM-81-BASIC-005, dated October 1980.

SECTION 4

SUMMARY

The BASIC program and its laboratory provide for the timely integration, test, and validation of advanced system architectures, new subsystems, and advanced technology products in advanced system configurations.

The laboratory produces technical reports, inputs for engineering development specifications, design guidelines, technology data base updates and assessments, technological risk assessments, and interface information. It also validates advanced architecture, hardware and software in their developmental stages and evaluates and demonstrates system and processing architecture.

BASIC supports platform offices during the concept formulation and concept validation phases of their programs. The capital investment made in the BASIC Laboratory need not be duplicated for each program.

The enhanced transfer of advanced technology to the platforms yields a demonstrated return on the Navy's R&D investment.

The BASIC Program Management Plan provides additional information on future BASIC program planning, objectives, and output.

APPENDIX A

DOCUMENTATION SUMMARY

A.1 INTRODUCTION

This section lists the documents prepared by the BASIC Project Office.

A.2 DOCUMENTATION (BIBLIOGRAPHY)

1. BASIC Acoustic Generation System (AGS) Support Plan (October 1980), Report No. 4092TM-80-BASIC-007 -- Presents the BASIC Laboratory's support of the AGS program real-world acoustic simulation. BASIC provides the host data processor for problem control and geometry functions. The laboratory will integrate this function with AIDS and Advanced ASW Processing Techniques (ADAPT) to fulfill the AGS-NAVAIRDEVCEN capability.

2. BASIC-ASPC Support Plan FY81 through FY84 (September 1980), Report No. 4092TM-80-BASIC-006 -- Describes the support that the BASIC Laboratory will provide to the ASPC program. The ASPC program's objectives are to develop, computer program, and demonstrate an acoustic/environmental correlation algorithm to speed up airborne antisubmarine warfare (ASW) localization. The BASIC Laboratory will support the ASPC program by providing: (a) a host system as a sensor simulation facility; (b) laboratory facilities; and (c) skilled personnel to install, validate, and demonstrate computer programs.

3. AAAS Multiplex Armament Data Word Standardization Study (September 1980) Report No. 4092TM-80-BASIC-005 (Draft) -- Presents standardized data formatting for MIL-STD-1553 armament multiplexed data buses.

4. TACAMO Avionic System Upgrade Proposed Approach (October 1980), Report No. 4092TM-80-BASIC-004 -- Presents concepts and related planning factors to the TACAMO Program Office for upgrading the EC-130/EC(X) flight deck and mission control stations.

5. System Implementation and Integration Progress Report (May 1980), Report No. 4092TM-80-BASIC-003 -- Provides BASIC's FY80 progress and accomplishments and planned FY81 and future efforts. The laboratory configuration and hardware summary are also presented.

6. Test Report: BASIC Laboratory Evaluation of Data Bus Voice Multiplex System (February 1980), Report No. 4092TM-BASIC-001 -- Describes tests performed on the Garrett Air Research 1553B data bus voice multiplex system. These tests were aimed at establishing the duty cycle or load on the multiplex bus and the effects of sampling rate on voice quality.

7. Automatic Operator Console Response System of the CMS-2Y Compiler Monitor System for Use With the CV-ASWM FASP System (January 1980), Report No. 503-TM-80-BASIC-001 -- Presents a software program to fulfill the needs of the CMS-2Y compiler monitor system for enabling a job to run successfully under the CV-ASWM Facility for Automated Software Production (FASP) System.

8. RLGN/1553A Interface Tests (5 December 1979), Report No. 503-TM-79-BASIC-011 -- Describes the tests performed on the Ring Laser Gyronavigation (RLGN) System, emphasizing the determination of the RLGN-to-1553 interface capability.

9. System Implementation and Integration Progress Report (October 1979) -- Describes the BASIC Laboratory's capabilities and accomplishments for FY79.

A.3 PREVIOUS YEARS' DOCUMENTATION

The following list indicates previous years' documentation. Further information on these reports is in the System Implementation and Integration Progress Report (May 1980), Report No. 4092TM-80-BASIC-003.

1. BASIC Support of the VTXTS Program (29 August 1979)

2. F-14 BASIC/MSC Evaluation Demonstration Approach (30 July 1979)

3. Preliminary BASIC/V/STOL Support Plan (30 July 1979)

4. BASIC Laboratory Architecture Plan (17 May 1979)

5. BASIC/S-3A Multiplex Architecture Applications Demonstration White Paper (22 March 1979)

6. CH-53 Integration Program Plan (9 February 1979)

7. BASIC Configuration 1 -- System Implementation and Integration Progress Report (September 1978)

8. BASIC Support Plan for the F-14 CILOP (30 June 1978)

9. BASIC Program Management Plan for Fiscal Year 1978 through 1984 (30 June 1978)

10. BASIC Telephonics Multiplex Terminal Programming (13 June 1978), Report No. 503TM-78-BASIC-001

11. BASIC Software Program Design Specification (June 1978)

12. BASIC Support Plan for the V/STOL (28 February 1978)

13. TTL Software Plan (1 February 1978), Report No. 503TM-78-TTL-004

14. BASIC Software Design Concept (June 1977)

15. BASIC Configuration 1 -- System Implementation and Integration Progress Report (May 1977)

16. ASW Mission Requirements, Volumes 1 through 6 (April 1977)

17. BASIC Configuration 1 -- Computer Program Report (March 1977)

18. BASIC Configuration 1 -- Multiplex Terminal Definition Summary (March 1977)

19. BASIC Configuration 1 -- Test Plans and Procedures (February 1977)

20. Final Report: Support Configuration Recommendations for BASIC Generic Configuration 1 (22 December 1976)

21. Report to BASIC: Laboratory Software Summary (16 December 1976)

22. BASIC Configuration 1 -- Test Controller Report (December 1976)

23. Report to BASIC: DSPADS Laboratory Hardware Status (16 November 1976)

24. BASIC Configuration 1 -- Operational System Definition (25 October 1976)

25. BASIC Configuration 1 -- Test Objectives Report (24 September 1976)

26. BASIC Configuration 1 -- Multiplex Interface Module Specifications (1 June 1976)

27. BASIC Configuration 1 -- Definition (31 March 1976)

APPENDIX B

BASIC LABORATORY DESCRIPTION

B.1 INTRODUCTION

B.1.1 Objective

The BASIC Laboratory provides for the transition of technologies from exploratory and advanced development stages to use on advanced platforms. BASIC assists platform programs in their concept formulation and definition phases. The BASIC facility can be used to evaluate alternatives, assess technology, and provide inputs to DSARC I and II. The availability of the BASIC facility reduces the leadtime needed for platform program laboratories and project implementations and decreases duplicative capital investments.

B.1.2 Functions

The BASIC Laboratory has an advanced system architecture, multiplex integration technology, and distributed processing system in which advanced technology products can be integrated, demonstrated, and evaluated. The system contains multiplex and system test stations and associated software for testing and reducing data. A universal controller executive adds to the capabilities to interface and integrate new technology products and concepts and conduct architectural evaluations. The The capability is being developed for conducting dynamic system operations in accordance with a canned routine or scenario. Further, interactive operator action for scenario and time-sequenced events will be implemented, and simulation will be provided soon for sensors including FLIR, acoustic, and so forth.

B.2 LABORATORY DESCRIPTION

B.2.1 Capabilities

The BASIC Laboratory provides the following capabilities to accomplish its objectives and perform its functions:

1. Multiplex -- Interfaces and integrates advanced technology products, equipment, subsystems, and systems. Evaluates multiplex operational modes, control, executives, and dedicated and hierarchical-layered bus systems.

2. Architecture -- Analyzes, implements, demonstrates, and evaluates central, federated, distributed, and embedded processing architectures.

3. Demonstration test and evaluation (DT&E) -- Provides DT&E for technologies, systems, alternatives, critical issues, algorithms, software, and simulation.

4. Operator interface -- Provides advanced programmable displays and controls for operator interaction, conducting tests, data input and output, and running scenarios.

5. Algorithm implementation -- Provides programmable resources to verify and validate algorithm implementation.

6. Host systems -- Serves as sensor or avionics simulation facility developing multisensor correlation algorithms, generates tracks, determines navigation errors and system errors, simulates algorithms, and computes evaluation parameters.

7. Software development -- Provides programmable resources for implementing, testing, and debugging certain software programs and algorithms.

8. Bus test -- Provides in-place facilities for extensive multiplex bus testing, monitoring, word generation, and diagnostics.

9. System test -- Provides a computerized system test station for diagnostics, data collection, analyses, monitoring, and data reduction.

10. Reporting -- Generates technical reports, test reports, test plans and procedures, technology assessments, and other documentation as requested to support activities in using the laboratory. A data base is maintained and is accessible.

B.3 RESOURCES

B.3.1 Hardware Summary

Table B-1 and the following paragraphs summarize the hardware status for the BASIC Laboratory advanced system architecture implementation. Figure B-1 is a simplified block diagram of the BASIC facility.

B.3.2 Multiplex Bus Test Station

The use of special-purpose test hardware provides a high degree of flexibility in testing the various multiplex terminals and simulating multiplex system operation in command/response, polled contention, or dynamic bus allocation. The special-purpose test hardware is listed and described below.

B.3.2.1 Single-Command Word Generator

The single-command word generator interfaces with one or two multiplex buses in accordance with the interface characteristics of MIL-STD-1553A or MIL-G-85013(AS).

B.3.2.2 Real-Time Bus Monitor

The real-time bus monitor provides the capability for examining the traffic and message transfers occurring on the multiplex bus.

TABLE B-1. HARDWARE STATUS

HARDWARE	STATUS
Special-Purpose Test Hardware	
Single-Command Word Generator (1)	Operational
Real-Time Bus Monitor (1)	Operational
Command Message Generator (1)	Operational
Bus Traffic Storage Control (1)	Operational
Interface Modules, Naval Tactical Data System (NTDS)	Operational
AN/UYK-15 Simulator (1)	Operational
Z-2 Interface Modules (5)	Operational
CONRAC Bus Monitor (1)	Operational
Fairchild Data Bus Monitor/Controller (DBMC) (1)	Operational
Multiplex Terminals	
Telephonics Data Terminal (2)	Operational
Actron Data Terminal (1)	Operational
Avionics Data Bus System (1), redundant	In place and operational
Garrett Audio Terminal (5)	Operational
Garrett Audio Multiplex Bus Controller (1)	Operational
Telephonics Multiplex Bus Controller (1)	Operational
Garrett Warning Tone Panel and Switching Panel (1)	Operational
Voice Switching Units (2)	Operational
AN/UYK-15 (1)	Mounted in rack, Operational
AN/UYK-15 FFT (1)	Installed
Hazeltine 2000 CRT Terminal (1)	Operational
Tektronix 4051 Graphics Display Terminal (1)	Operational
Tektronix 4631 Hard Copy Unit (1)	Operational
Wangco Disk (1)	Operational
Dataproducts Line Printer 2230 (1)	Operational
Kennedy Magnetic Tape (2)	Operational
Pertec Magnetic Tape (2)	Operational
Peripheral Dynamics, Inc. Card Reader (1)	Operational
AN/AYK-14 Computer (2)	Operational
Control Console Unit (CCU) (3)	Operational
Computer Loader Verifier (1)	Operational

TABLE B-1. HARDWARE STATUS (Continued)

HARDWARE	STATUS
Cromemco Z-2 Microcomputers	Operational
Dual Floppy Disks (3)	Operational
Lear-Siegler ADM-3A CRT and Keyboard Terminals (8)	Operational
Hazeltine 2000 CRT Terminal (1)	Operational
Teletype Co., TTY's Model 43 (2)	Operational
Joysticks (2)	Operational
Controls and Display Subsystem	
Side-by-side Cockpit Mockup (1)	
VSD (1)	Installed
HSD (1)	Installed
Situation Advisory Displays (SAD's) (3)	Operational
Map Display (1)	Installed
TACCO Display (1)	Installed
Univac Fiber Optic Demonstration System (1)	Installed
Chromatics Color Display Terminal with Dual Floppy Disks (1)	Operational
VAX 11/780 Computer	Operational
Disk Subsystem, VAX 11/780 (1)	
Digital Equipment Corporation LA-36 DEC-writer II (2)	Operational
Universal Remote Terminal (URT)	Installed
Digital Equipment Corporation LA-12 DEC-writer (1)	Operational
Modem, RACAL-VADIC, 1200 Baud (1)	Operational
Modem AJ 1234, Anderson Jacobson, 1200 Baud (1)	Operational
Modem AJ 242, Anderson Jacobson, 300 Baud (4)	Operational
Video Interface Unit (1)	Operational
Telephonics Terminal Interface Modules (3)	Operational
Integrated Avionics Control System (Army)	Operational
Primary Control Panel (PCP) (1)	Operational
Secondary Control Panel (SCP) (1)	Operational
Primary Remote Terminal (1)	Operational
Secondary Remote Terminal (1)	Operational

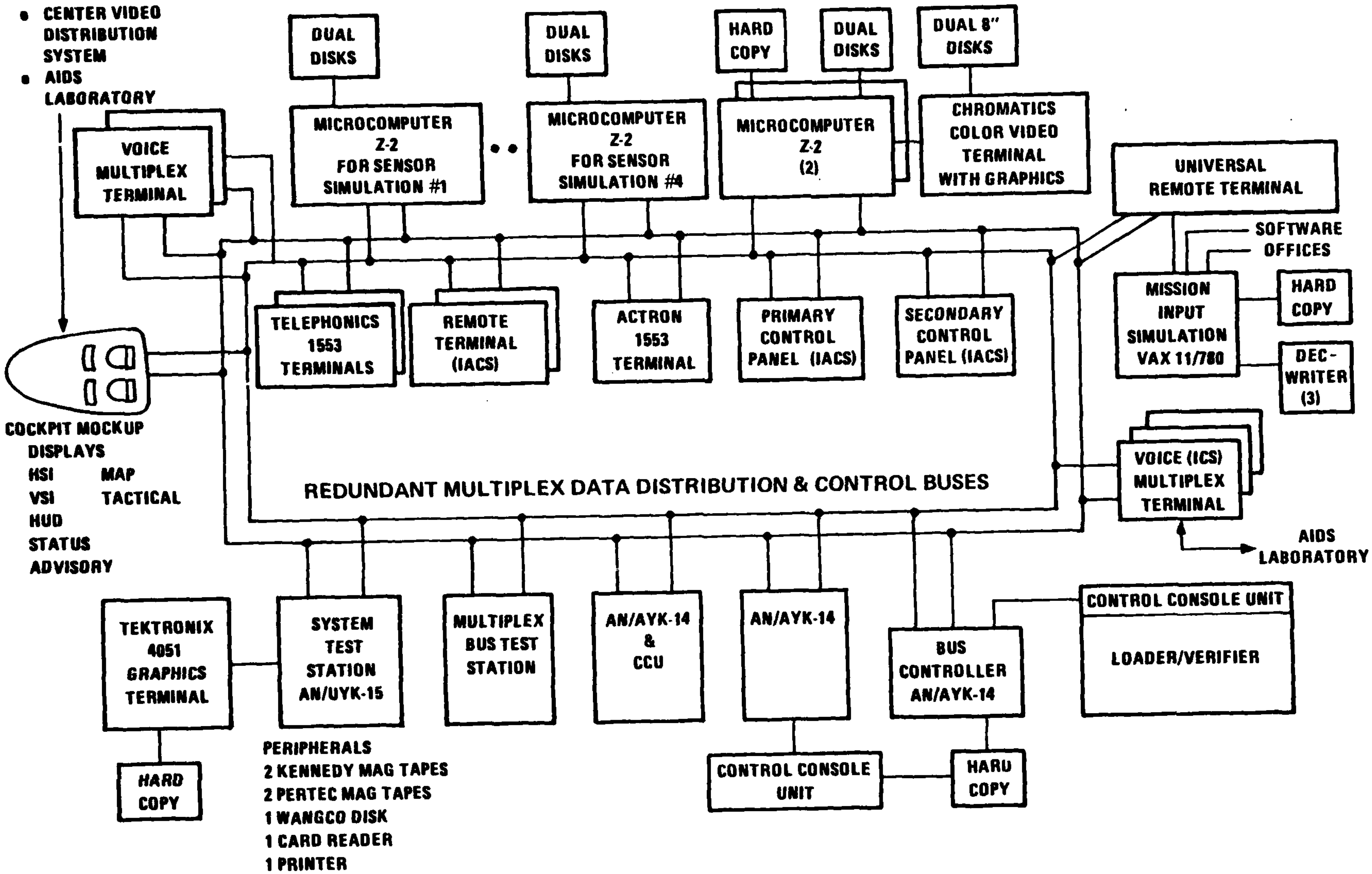

Figure B-1. BASIC Laboratory Configuration

B.3.2.3 Command Message Generator (CMG)

The CMG initiates commands in accordance with a polling sequence entered into the generator or generates command word pairs in accordance with a directory and selected update rate. This message generator acts as a command controller of the command/response system or dynamic bus allocation system, depending on the mode of operation selected. Spacing between commands can be selected to provide various traffic densities on the multiplex bus.

B.3.2.4 Data Word Generator/AN/UYK-15 Simulator

During initial testing, when the AN/UYK-15 and its software are not available to provide data input/output (I/O) with the multiplex terminals, a word generator will provide the data words for the messages.

B.3.2.5 Bus Traffic Storage Control

The panel has two functions: (1) to provide a "preview word," that is, an instruction from the AN/AYK-14 sent to the AN/UYK-15, which then enters a command sequence, and (2) to send all bus traffic to the AN/UYK-15 by direct memory access (DMA).

B.4 MULTIPLEX TERMINALS

Telephonics and Actron multiplex terminals are used in the laboratory.

B.4.1 Telephonics Terminals (ISC)

The Telephonics multiplex terminals were modified for BASIC Laboratory use, and the interfaces programmed. The terminals have been integrated with the laboratory multiplex buses.

B.4.2 GAC Terminals

The BASIC Laboratory has loaned two Grumman terminals to the Army.

B.4.3 Actron Terminals

The Actron remote multiplex terminal is being programmed for interfacing the multiplex buses with the Z-2 microcomputer.

B.5 AUDIO MULTIPLEX

B.5.1 Audio Multiplex Terminals

Five audio multiplex terminals are operating in the BASIC facility. The system can be expanded to support 20 subscribers. Audio is sampled at a 25-kHz or 50-kHz rate and converted to digital by a continuously variable slope delta (CVSD) modulator/demodulator. Data on the multiplex bus is transferred at 1 Mbps in data words per MIL-E-85013, which is similar to MIL-STD-1553. There are 17 data words per transfer plus overhead handshaking words.

B.5.2 Audio Multiplex Bus Controller

The audio multiplex bus controller is connected to the audio multiplex bus and audio multiplex stations. The bus controller controls the information transfers on the multiplex bus. A 10.13-ms frame interval (cycle) is used when an audio multiplex terminal uses a 25-kHz sampling rate. A 5.12-ms frame is utilized when the CVSD modulator/demodulator uses a 50-kHz sampling rate.

B.5.3 Warning Tone Panel and Switching Panel

The warning tone panel generates five different warning tones: IFF, SONAR, RAWS, ACT ALERT, and LO GR. One switching panel has a switching matrix to distribute the five different warning tones to the five individual audio stations.

B.6 AN/UYK-15 COMPUTER (SPERRY UNIVAC) AND FAST FOURIER TRANSFORM UNIT

The system test station's AN/UYK-15 is operational. It has provisions for 16 I/O channels. It has 64K of addressable memory and memory parity, 2 sets of additional registers, and a 10-kHz clock for operations. Peripherals available for the AN/UYK-15 include:

1. AN/UYK-15 Fast Fourier Transform (FFT) Unit
2. One Hazeltine 2000 Terminal (with keyboard and CRT display)
3. Two Pertec Magnetic Tape Units
4. Tektronix 4631 Hard Copy Unit
5. Tektronix 4051 Graphics Display Terminal
6. Card Reader
7. Wangco F2221 Disk
8. Two Kennedy 9100 Magnetic Tape Units

The FFT is capable of handling large amounts of data reductions.

B.6.1 NTDS Interface Modules

A set of standard modules provides an interface between the NTDS fast channels of the AN/UYK-15 and the multiplex terminals.

B.7 AN/AYK-14 COMPUTER (XN-2B) AND (XN-1)

Three AN/AYK-14 computers (Navy standard airborne computers) have been integrated with the multplex buses and have software installed for multiplex bus controller operation. Future applications for the AN/AYK-14's include subsystem applications and system executive control.

B.8 CROMEMCO Z-2 MICROCOMPUTERS

Five Cromemco Z-2 microcomputers are installed and operational. Navigation, ESM, and radar simulation software has been written and installed. Other selected subsystems will be simulated on the Z-2's. A Z-2 microcomputer has been successfully interfaced with to the CDC 6600 computer and the 1553 data bus. Peripherals available include:

1. Dual floppy disk (3)

2. Lear Siegler ADM-3A CRT and Keyboard (5)

3. Teletypewriter (TTY) (2)

4. Digital Equipment Corporation LA-36 DECwriter II (2)

B.8.1 Interface Module (IM)

The first three 1553 multiplex bus-to-Z-2 microcomputer interface modules are fully operational. The remaining two modules are being debugged.

B.9 VAX 11/780 COMPUTER

This new computer was recently installed in the BASIC Laboratory. The VAX (PDP) 11/780 was selected primarily because of the availability of software developed on other programs. It will be used to run various mission programs that generate signals and timing representing the system input parameters and their variations, as would be encountered during typical mission phases. The VAX 11/780 can provide equipment simulation in addition to that provided by the Z-2 microcomputers. A URT is installed within the VAX 11/780 housing to interface the VAX 11/780 with the 1553 bus system. The URT allows the VAX to provide total subsystem simulation.

B.10 CONTROL AND DISPLAY SUBSYSTEM

AIDS personnel have installed a side-by-side cockpit mockup in the BASIC facility. Included in the mockup are:

1. Vertical situation display (VSD)

2. Horizontal situation display (HSD)

3. Map display

4. Tactical coordinator (TACCO) display

5. SAD's (3)

Interface cabling between the AIDS Laboratory and the BASIC facility has been installed and is operational. The above displays can be driven by the AIDS simulation equipment.

The cockpit displays are planned to be tied into the BASIC core avionic system to fulfill laboratory control and display functions.

B.11 COLOR GRAPHIC DISPLAY

The Chromatics color graphic display terminal is interfaced with the bus through one of the Z-2 microcomputers. The display is used to investigate formats, interfaces, data correlation, and information extraction related to tactical display requirements.

B.12 FAIRCHILD BUS MONITOR

A Fairchild bus monitor is being used for bus problem analysis. This bus monitor is an integral part of the 1553 bus system and has an RS-232 I/O for remote control and printout of data.

DATE
ILME